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INFLUENCE OF FOOD SUBSTITUTES' DIET ON WEIGHT REDUCTION IN PHYSICALLY ACTIVE OBESE PEOPLE

Introduction

According to a study of the National Centre of Social Health in 2010-2011 30% of Bulgarian students aged between 6 and 19 were overweighed and 12% were obese. The data for the countries in the Euro zone were even more alarming: between 36. 9% and 56. 7% of women and between 51% and 69. 3% of men were overweight and obese (Health status statistics, 2013). Higher risks for morbidity of diseases with big social impact (such as type 2 diabetes and cardiovascular disease) are associated with obesity in young people (Levine, J. A. and Kotz, C. M., 2005, Pisunyer FX., 1993). At the same time we couldn't find in the scientific literature any widely accepted methodologies (which combined physical activity and dieting) designed to address these problems. In our opinion the methodology presented in this article could be used as a practitioner's guide for treating obesity.

There are a number of studies treating similar problems (Cullinen K, Caldwell M., 1998; Borsheim E, Bahr R., 2003). Despite the fact that there are studies of daily regimens which combined resistance exercises and negative energy balances, we did not found one which had tested the effectiveness of a methodology similar to ours. The conclusion is that combining resistance training workouts of anaerobic-lactic type with a low-calorie diet is an entirely new approach for treating obesity.

Methods

The aim of the study was to evaluate quantitatively the influence of a daily regimen, consisting of resistance training sessions of anaerobic-lactic type combined with a low-calorie diet on the body mass components and the quality of life perception of obese people.

We studied 15 sedentary subjects, 12 women and 3 men, aged between 20 and 45 with Body Mass Index (BMI)>27. We used the Miflin et al. (Mark D Miflin, 1990) methodology and the Levine and Kotz (Levine, J. A. and Kotz, C. M., 2005) methodology to estimate the theoretical energy expenditure in rest and the theoretical daily energy expenditure for every participant. All subjects completed the experiment successfully.

For every subject was the following parameters were measured:

1. Using the bioimpedance methodology (Nuñez C et al., 1997) the body composition has been estimated (as proportions of lean body mass and fat tissue) in the beginning and after that every two weeks;

2. Using the World Health Organization Quality of Life Index Inquiry, 1999 (WHO Quality of Life Index, 1999) the quality of life perception was measured (twice – once in the beginning and once at the end of the study)

The energy deficiency was achieved via reduction of the calorie intake using either food substitutes (for group 1) or conventional food sources (for group 2). We used the products of EURODIET Company.

We separated the participants randomly into 3 groups. The first two groups (4 women and 1 man for the first one and 6 women and 1 man for the second one) were put on a diet with 30% calorie deficiency (comparing to the theoretical daily energy expenditure) with the following proportions of food ingredients: 55-60% of carbohydrates, 15-20% of protein and 25-30% of fats. The diet consisted of 5 meals and the first experimental group consumed Eurodiet food substitutes for 3 of them. We controlled the pursuance of the regimen using a feedback loop mechanism – every participant had to complete protocols for the food he/she consumed on a daily basis. The third group (consisting of 2 female and 1 male) was a control one – no restrictions on the food intake were put on the subjects.

Every participant went through physical training sessions with the following parameters: Duration – 8 weeks; Workouts duration – 30 min; Frequency– 3 times a week; Intensity – about 70% of the maximum, determined as a subjective feeling of muscle failure (12-15 repetitions); Density and volume – 3 sets of a circuit training program, consisting of 10 exercises with 10 – 15 sec. resting periods between them.

The idea behind putting the participants on a training program with such parameters was to achieve maximum density of the workouts combined with a great variety of exercises in order to keep the interest and the motivation of the subjects elevated. We tried to use (as far as it was possible considering the bodyweights of the subjects) complex, basic exercises, which engaged big muscles and muscle groups in order to increase as much as possible the energy expenditure of the participants (Peeva, D, Antonov, A, Ianchev, N, 2007). These types of exercises spend a lot of energy and have low values of the Coefficient of Useful Action (Basalkin, Vl, Slepchuk, NA, 1991, Hawkins D[1], Molé P, 1997). These way great amounts of energy substrates have to be chemically decomposed for energy. These substrates are oxidized only partially during the activity and their remainders are decomposed during the rest periods and energy is spent even then. Thus these processes spend a lot more energy then the aerobic exercises which are more energy sparing (D.A. Winter and H.J. Yuck, 1987).

In order to improve the cardiovascular fitness of the participants before we switched to abovementioned training methodology, we had put the subjects on a two-week endurance training program consisting of 30 min. jogging or cycling workouts 3 times a week.

Table 1. *ANOVA*

		Total Mean squares	Mean square	F	Significance
Body mass	**Between groups**	35.35	17.67	0.12	0.89
	In the groups	1768.77	147.40		
	Total	1804.12			
% fat tissue	**Between groups**	7.77	3.88	0.09	0.91
	In the groups	516.54	43.05		
	Total	524.31			
BMI	**Between groups**	5.73	2.87	0.20	0.82
	In the groups	169.42	14.12		
	Total	175.15			
Inquiry points	**Between groups**	2090.21	1045.11	1.89	0.19
	In the groups	6623.52	551.96		
	Total	8713.73			

Table 2. *Variation analysis*

Group	Measure	Body mass	% fat tissue	BMI	Inquiry points
1	**Range**	9.2	32.6	15.8	5
1	**Minimum**	72.1	72.1	29.5	29
1	**Maximum**	81.3	104.7	45.3	34
1	**Mean**	89.24	89.240	38.380	31.60
1	**Standard error**	4.62	5.4738	2.8847	.964
1	**Standard deviation**	12.24	12.2398	6.4503	2.155
1	**Variance**	149.81	149.813	41.607	4.645
2	**Range**	29.60	74.30	103.90	86.4143
2	**Minimum**	19.90	22.50	42.40	37.9714
2	**Maximum**	14.20	28.00	42.20	32.4143
2	**Mean**	68.00	32.00	100.00	58.8571
2	**Standard error**	29.60	74.30	103.90	86.4143
2	**Standard deviation**	19.90	22.50	42.40	37.9714
2	**Variance**	14.20	28.00	42.20	32.4143
3	**Range**	30.4	9.1	3	23
3	**Minimum**	78.2	30.6	32	32
3	**Maximum**	108.6	39.7	35	55
3	**Mean**	89.833	36.400	33.33	43.33
3	**Standard error**	9.4728	2.9092	.788	6.642
3	**Standard deviation**	16.4074	5.0388	1.365	11.504
3	**Variance**	269.203	25.390	1.863	132.333

Results

For checking differences between the groups for each variable we conducted a standard test for differences in mean values – ANOVA (table 1) (Introduction to ARIMA, DU, 2013, The ARIMA procedure, SAS Online, 2013, TS models algirithms, IBM Support Portal, 2013). We did this to test for the success of the randomization of the groups. We considered the data met the assumptions of the test (approximately). Based on the results shown on the table we could conclude that there are no reasons to reject the hypothesis that there are no differences between the means of the studied variables between the groups ($p \leq 0.05$). Table 2 exhibits the variation analysis of the studied variables.

The results of the studied variables in the beginning and at the end of the experiment are presented on table 2. We used t-test for paired samples to calculate the statistical significance of the differences (Papoulis, A., 1991).

Discussion

There were no significant differences between the values of the variables in the beginning and at the end of the study for the control group. The differences in the experimental groups were significant for all of the variables with one exception – the proportion of fat tissue for the first experimental group. Nevertheless the mean differences for the second group were greater (and almost equal for the body mass) everywhere. Interestingly the margins of error for the differences in BMI in experimental groups suggest that there were a (slight) chance that the subjects increased (or did not change) their BMI during the experiment.

Table 2. *Paired Samples t-tests*

	Mean	Standard deviation	Standard error	t	Significance	Margin of error
Group 1						
Body mass	3.94	2.11	0.95	4.17	0.01	3.96
% fat tissue	1.36	1.82	0.81	1.67	0.17	1.35
BMI	1.38	0.72	0.32	4.31	0.01	<1.38
Inquiry points	-14.40	18.46	8.26	-1.74	0.05	14.37
Group 3						
	Mean	**Standard deviation**	**Standard error**	**t**	**Significance**	**Margin of error**
Body mass	3.91	2.58	0.97	4.02	0.01	3.9
% fat tissue	2.17	2.31	0.87	2.49	0.05	2.17
BMI	1.44	1.03	0.39	3.72	0.01	1.45
Inquiry points	-26.86	19.00	7.18	-3.74	0.01	26.85

Group 3						
	Mean	**Standard deviation**	**Standard error**	**t**	**Significance**	**Margin of error**
Body mass	1.70	0.82	0.47	3.60	0.07	1.69
% fat tissue	-1.03	3.47	2.00	-0.52	0.66	1.04
BMI	0.03	0.92	0.53	0.05	0.96	0.027
Inquiry points	-2.67	1.53	0.88	-3.02	0.09	2.66

We found that the percentages of the fat tissue had changed for the participants in the experimental groups (although insignificantly for the first group). We consider this an important result because it means that the body weight reduction was achieved largely by decreasing the quantity of the fat tissue and sparing the muscle tissue. It follows that the relative quantity of lean body mass increased and it is well known that lean body mass consumes a lot more energy than fat tissue. This would eventually permit the subjects to consume more energy while keeping the energy balance of the body (compared with the same body weight and the previous body composition). This is especially important for obese people for the reason that to achieve a negative energy balance these people are obliged to maintain very restrictive diets (at least initially) and it is pretty difficult to adhere to such diets for long periods of time. The discontinuance of the regimen and the following (in most cases – in our experience) switching to a strongly positive energy balance leads to a yo-yo effect and an increasing of the fat tissue proportion. This way a vicious circle could be entered – after every consecutive round of such diet – failures the patient ends up with more fat tissue than in the beginning.

We reached to the following conclusions:

1. These results are quite different from the ones we found in our previous studies. In our opinion the reason for the insignificance of the differences for the fat tissue proportion of the first group is the relatively small number of the participants in this group. In this study the results were not in favor of the presumption of a superiority of food substitutes to natural food sources when dealing with obesity;
2. Combining low-calorie diet with resistance training induces an effect of sparing of lean body mass while losing weight – a process of big importance for subjects with a lot of fat tissue;
3. We consider the lack of significant differences in the results of the control group as an evidence in favor of the hypothesis that physical activity alone is insufficient for body weight and fat tissue reduction – probably the participants in this group had adjusted their energy intakes to the elevated energy expenditures due the physical activity this way reaching an energy balance. It is important, however, to mention that the studied sample was quite small for that group;

4. Considering the margins of error for the statistically significant differences, the results have to be interpreted cautiously.

Acknowledgement
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Introduction: The rate of obesity among people in many countries escalated in recent years. A lot of different methodologies were implemented to address this problem. To address these problems in this study we tried to evaluate the impact of a daily schedule, consisting of physical activity of anaerobic-lactic type (20-30 sec), combined with an energy deficient diet (achieved using either EURODIET food substitutes or conventional food sources) on the components of body mass and the Quality of Life Index. Methods: The participants were 15 healthy adults of both sexes with Body Mass Index (BMI) values above 27. They were randomly assigned to 3 groups – the first one underwent an energy deficient diet using the products of EURODIET for 3 of the daily meals. The second one achieved the energy deficit adhering to a diet consisting of conventional food sources. The third group was the control one with no dietary restrictions imposed on the subjects. All 3 groups performed 30 min. circuit training sessions of resistance exercises 3 times a week. The study was 8 weeks long. Results. The differences between the initial and the final values of BMI, the body mass, the percentage of the fat tissue and the Quality of Life Index were compared. We detected statistically significant differences ($p \leq 0.05$) in the following variables and groups: 1. Body mass and BMI in Eurodiet group; 2. Body mass, Quality of Life Index and BMI in conventional diet group. No significant differences ($p \leq 0.05$) between the initial and the final values of the studied variables of the control group. Discussion: We found no evidence that a diet with food substitutes is superior to a conventional diet for losing body weight. Contrary to our previous studies we found that a conventional diet is superior to a food substitutes' diet in sparing the lean body mass. In our opinion implementing physical activity alone is insufficient for achieving weight loss. It is possible that these findings were due to the relatively short duration of the study. When interpreting the results of the study we have to consider the relatively small number of participants in all 3 groups.

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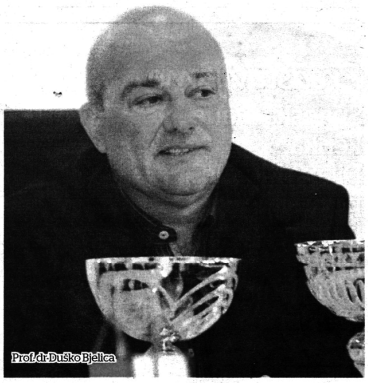

Prof.dr Duško Bjelica

NIKŠIĆ - Prijavljivanje radova za 11. Međunarodnu naučnu konferenciju o transformacionim procesima u sportu, pod nazivom „Sportska dostignuća“, i za učešće na 10. kongresu Crnogorske sportske akademije zaključeno je 15. januara.

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Prema riječima predsjednika prireďivačkog odbora kongresa, prof.dr Duška Bjelice, značaj ovog skupa prepoznali naučni radnici sa svih strana svijeta.

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Ra.P.